Time and Spatial Averaging Module

OPERATION & MAINTENANCE
MANUAL
for
Model 8696

narda
A Subsidiary of LORAL

OPERATION AND MAINTENANCE MANUAL FOR MODEL 8696

Time and Spatial Averaging Module

Equipment Serial No. _____

THE NARDA MICROWAVE CORPORATION

WARNING

ELECTROMAGNETIC RADIATION

USER MAY BE EXPOSED TO POTENTIALLY HAZARDOUS ELECTROMAGNETIC RADIATION DURING OPERATION. REVIEW AND ADHERE TO ALL SAFETY PROCEDURES.

WARRANTY

INFORMATION. The Narda Microwave Corporation warrants each product of its manufacture to be free from any defect in material and workmanship for a period of one year after delivery to, and return by, the original purchaser. All warranty returns, however, must first be authorized by factory office representatives.

The limit of liability under this warranty shall be to repair or replace any product, or part thereof, which proves to be defective after inspection by Narda. This warranty shall not apply to any Narda product that has been disassembled, modified, physically or electrically damaged or any product that has been subjected to conditions exceeding the applicable specifications or ratings.

The Narda Microwave Corporation shall not be liable for any direct or consequential injury, loss or damage incurred through the use, or the inability to use, any Narda product.

The Narda Microwave Corporation reserves the right to make design changes to any Narda product without incurring any obligation to make the same changes to previously purchased units.

This warranty is the full extent of obligation and liability assumed by the Narda Microwave Corporation with respect to any and all Narda products. Narda neither makes, nor authorizes any person to make, any other guarantee or warranty concerning Narda Products.

TABLE OF CONTENTS

Section		Page
I	GENERAL DESCRIPTION	
	1-1. Introduction	1-1
	1-3. Description	1-2
	1-12. Specification	1-3
II	OPERATION	
	2-1. General	2-1
	2-3. Preliminary Inspection . .	2-1
	2-5. Battery Installation . .	2-1
	2-7. Operational Controls and Indicators	2-2
	2-9. Connecting the 8696 to a Model 8616 or 8716 . .	2-6
	2-10. Initial Electrical Checkout	2-7
	2-11. Calibrating the 8696 for Use With an 8616 or 8716	2-9
	2-15. Optimizing Procedure . .	2-9
	2-17. Operation	2-11
	2-21. Operational Notes	2-12
	2-22. Power Density Measurements on Rotating Beam Radars	2-15
III	THEORY OF OPERATION	
	3-1. Block Diagram Discussion	3-1
	3-3. Built In Test Functions	3-1

TABLE OF CONTENTS (Cont)

Section		Page
IV	MAINTENANCE	
	4-1. Calibration	4-1
	4-3. Calibrating an 8696 for Use With an 8716	4-1
	4-4. Calibrating an 8696 for Use With an 8616	4-3
	4-5. Troubleshooting	4-4
	4-8. Equipment Required for Troubleshooting	4-6
	4-9. Troubleshooting Notes . .	4-6
V	REPLACEABLE PARTS	
	5-1. General	5-1
	5-3. Ordering Information . .	5-1
	5-7. Customer Repair Service	5-2
VI	SCHEMATIC DIAGRAM	
	6-1. General	6-1

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Model 8696 Time and Spatial Averaging Module	1-1
2-1	Model 8696 Radiation Averaging Module Controls and Indicators	2-2
2-2	Model 8696 Radiation Averaging Module Typical Operational Setup	2-8
3-1	Model 8696 Radiation Averaging Module Simplified Block Diagram	3-3
5-1	Model 8696 Radiation Averaging Module Parts Location Diagram	5-10
6-1	Model 8696 Radiation Averaging Module Schematic Diagram	6-2

LIST OF TABLES

Table		Page
1-1	Specifications	1-4
2-1	Operational Controls and Indicators	2-3
2-2	LCD Annunciators and Codes	2-5
4-1	Troubleshooting Chart	4-5
5-1	Manufacturer's Code	5-3
5-2	Replaceable Parts List	5-5

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

1-2. This manual contains complete instructions for the operation of the Model 8696 TIME AND SPATIAL AVERAGING MODULE (Figure 1-1), hereinafter referred to as RADIATION AVERAGING MODULE, designed and manufactured by The Narda Microwave Corporation, Hauppauge, New York 11788. This manual includes a general description of the equipment, operating instructions and servicing procedures.

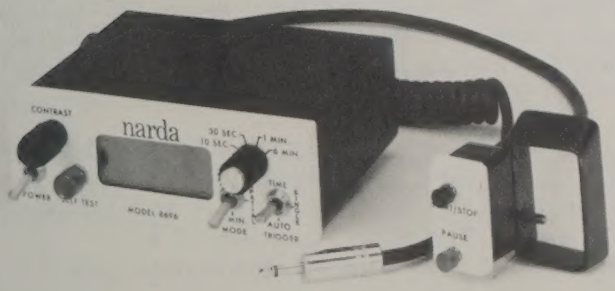


Figure 1-1. Model 8696 TIME AND SPATIAL AVERAGING MODULE

1-3. DESCRIPTION.

1-4. The Narda Model 8696 RADIATION AVERAGING MODULE is a completely portable microprocessor based instrument which is used in conjunction with the Narda 8600 and 8700 Series Radiation Monitors. The module adds time and spatial averaging capabilities to the radiation monitors as recommended in the new ANSI and Intl. standards. Power densities are averaged for either a fixed time period or for a user controlled time frame. This second mode allows the user to obtain spatial averages.

1-5. The operational controls of the 8616 and 8716 Radiation Monitors are not affected by the addition of the averaging module. However, the MAX HOLD mode on the 8616 cannot be used simultaneously with the averaging function. If both maximum and average field density is required then two separate measurements must be taken. The 8716 can be used to make simultaneous maximum and average field measurements since its recorder output is not affected by the MAX HOLD switch.

1-6. The display of the RADIATION AVERAGING MODULE is given as a percent of fullscale for the range of the radiation meter and isotropic probe used. The time duration of a measurement may also be displayed.

1-7. Operating power is supplied by an internal 9V alkaline battery. An access door is provided in the rear of the module to replace the battery. Standard carbon 9V batteries may also be used, however, they would

have to be replaced more often. The front panel display will indicate "LO BATTERY" when the battery voltage has dropped below 5 volts.

1-8. Both six minute averaging, as proposed by the ANSI standard, and one minute averaging (Australian standard) are supported by the RADIATION AVERAGING MODULE. In these fixed time modes the module may be set for a single measurement or repetitive measurement with display update rates from 10 seconds to six minutes (one minute for Australian standard).

1-9. By selecting the SPATIAL mode the user controls both the beginning and end of the averaging cycle thus greatly simplifying a spatial average measurement.

1-10. Proper operation may be verified by the built in test (BIT) function. Additionally, the internal microcomputer and its outboard memory are automatically tested whenever the module is turned on. The LCD and its driver circuitry may be tested by observing its response during these self-tests.

1-11. The PAUSE control allows a measurement to be interrupted while the user resets a transmitter or steps around an obstacle.

1-12. SPECIFICATION.

1-13. Table 1-1 lists the specification for the RADIATION AVERAGING MODULE.

Table 1-1

Specifications

Operational Modes	Start/Stop: User controlled start and stop of averaging cycle. Cycle duration: 5 sec to 6 min. Fixed time: Averaging times are preset to either 1 or 6 minutes. 6 minute: Input signal is averaged for 6 minutes. 1 minute: Input signal is averaged for 1 minute. Single/Continuous: Active in fixed time modes only. Single: A single averaging cycle is completed and the average is displayed. Continuous: Averaging cycles are continually displayed and the display is updated at fixed time increments. Update Rates: Active only in continuous mode. After the initial averaging cycle (either 1 minute or 6 minutes) is completed the display is updated with the new running average every 10 sec, 30 sec, 60 sec or 360 sec (6 minute time only).

Table 1-1 (Cont)

Operational Modes (Cont)	Time Display: Active only when new averages are not being computed. Displays time duration of last measurement.
Pause Mode	Interrupts averaging cycle time for a duration under immediate user control.
Input Voltage	0 to 3VDC NOTE: 3VDC corresponds to full scale recorder output on 8616 and 8716 series radiation monitors. Static and reverse polarity protected.
Measurement Accuracy	+/- 2% FSI @ 23 deg. C +/- 3% FSI 0-50 deg. C
NOTE: When used with an 8600 or 8700 series radiation monitor readings are in % of full scale for the range and probe being used.	
Display Time Accuracy	+/- 0.2 sec.
Averaging Time Accuracy	+/- 0.2 sec.
Resolution	+/- 0.1% FSI +/- 0.1 sec.

Table 1-1 (Cont)

Display	4 digit LCD Readable in direct sunlight
BIT Functions and Displays	1. Microcomputer RAM-"E1" if failure. 2. EPROM or LATCH - "E2" if failure. 3. Control settings - "E3" if user controls set for non-operational conditions. 4. Self-Test Control - If depressed during measurement in any operational mode the displayed average will be 50.0 +/- 1.0 if instrument is operational. Lower or higher readings indicate a fault condition.
Battery	9V Alkaline, 550 mAh
Battery Life	60 hrs. min. 100 hr. typical
Environment	
Temperature	0 to 50 deg C operating -20 to +60 deg C storage
Humidity	0-99% non-condensing
Altitude	0-30,000 ft

Table 1-1 (Cont)

Mechanical	
Size (Overall)	Measurement unit: 4.89W x 1.71H x 4.76D (excluding remote switch box)
Weight	18 oz.

SECTION II

OPERATION

2-1. GENERAL.

2-2. This section provides the functional control description, operating instructions and precautions for the Model 8696 RADIATION AVERAGING MODULE.

2-3. PRELIMINARY INSPECTION.

2-4. This unit was tested and inspected at the factory before shipment. Immediately after unpacking the equipment visually inspect it for damage which may have occurred in transit, such as broken knobs, damaged switches, etc. If there is any evidence of damage, immediately file claim for damage in transit with the carrier.

2-5. BATTERY INSTALLATION.

2-6. The instrument is shipped with the battery not installed to prevent its premature discharge. To install the battery, proceed as follows:

a. Turn POWER switch off.

b. Remove the knurled screws on the rear panel battery cover.

c. Place the battery in the battery cover clip and snap the battery connector to the terminals.

d. Replace the battery cover and tighten down knurled screws.

2-7. OPERATIONAL CONTROLS AND INDICATORS. (Figure 2-1)

2-8. Table 2-1 provides a complete functional description of all Model 8696 RADIATION AVERAGING MODULE controls and indicators.

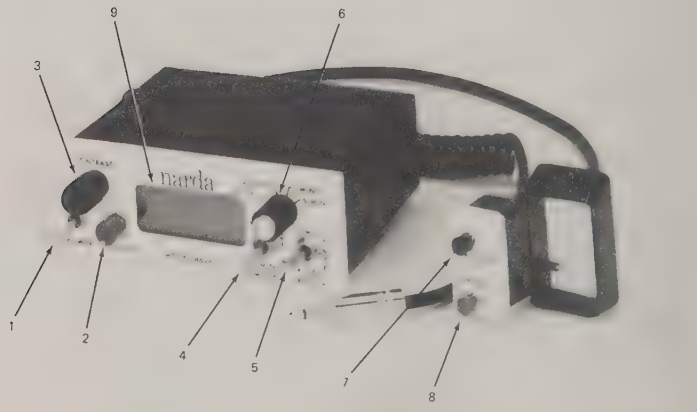


Figure 2-1. Model 8696 RADIATION AVERAGING MODULE Controls and Indicators

Table 2-1

Operational Controls and Indicators

Figure 2-1 Index No.	Control/ Indicator	Description
1	POWER Switch	Turns unit on and off.
2	SELF TEST	Provides a reference voltage equivalent to 50% of full scale when depressed to verify instrument accuracy.
3	CONTRAST	Provides means of adjusting LCD contrast to match ambient light.
4	MODE	6 MIN: Sets unit to average signal for a fixed 6 minute duration (ANSI Standard). 1 MIN: Sets unit to average signal for a fixed 1 minute duration (Australian Standard). SPATIAL: Sets unit to average over an operator controlled time frame. Used in determining spatial averages.

Table 2-1 (Cont)

Figure 2-1 Index No.	Control/ Indicator	Description
5	TRIGGER	SINGLE: Sets unit to make only one measurement. AUTO: Sets unit to make repetitive measurements. Active only in fixed time (6 min or 1 min) modes. TIME: Displays the duration of the last measurement. Active only when a measurement cycle is completed.
6	Update Rate Switch	10 SEC, 30 SEC, 1 MIN, 6 MIN: Changes LCD update rate. Active only in AUTO TRIGGER operation. Switch position does not affect fixed time SINGLE and SPATIAL measurements.
7	START/ STOP	Used to start all measurements, also used to stop measurements in the SPATIAL mode. Does not stop measurement in fixed time modes.

Table 2-1 (Cont)

Figure 2-1 Index No.	Control/ Indicator	Description
8	PAUSE	Used to pause a measurement. Pressed once to pause and a second time to continue.
9	LCD Display	4-digit liquid crystal display. Displays time and measurement information as well as status and error codes.

Table 2-2

LCD Annunciators and Codes

Display	Description
E1*	Error detected in microcomputer
E2*	Error detected in memory section
E3**	Controls set to improper combination

Table 2-2 (Cont)

Display	Description
Lo BATT*	low battery
Steady "----"	overrange input: will not clear until next measurement is completed. "
FLASHING MINUS SIGN	Indicates a measurement in progress in auto trigger
FLASHING DISPLAY	Indicates a measurement in progress in single trigger
Steady Display	No measurement in progress/measurement complete
SEC	Seconds

*Indicates FAULT which will halt all further operation.

**Cleared by setting switches in a valid combination.

2-9. CONNECTING THE 8696 TO A MODEL 8616 OR 8716.

a. The 8696 main chassis is attached to the 8616/8716 so that it sits directly above the analog meter (see Figure 2-2). The bracket supplied for mounting to an 8616 uses the two screws located on the top, rear of the 8616. The bracket supplied for mounting to an 8716 uses the carrying strap holding screws. Remove the aforementioned screws, place the mounting bracket over the holes and reattach the screws.

b. Slide the 8696 switch control chassis over the 8616/8716 handle. Tighten the knurled thumb screw until it is snug.

c. Position the two holding feet on the 8696 into the holding bracket slots. Push the 8696 back until its front panel is flush to the 8616/8716 front panel.

d. Plug the shielded phone jack into the 8616/8716 recorder output.

2-10. INITIAL ELECTRICAL CHECKOUT.

a. Connect the 8696 using the procedure given in paragraph 2-9.

b. Turn the 8696 power switch on. After approximately 1 second "8696" will be displayed followed by "0.0". Refer to maintenance section in the event of an improper display.

c. Set the 8696 front panel switches to SPATIAL and SINGLE. Depress and hold the SELF TEST pushbutton.

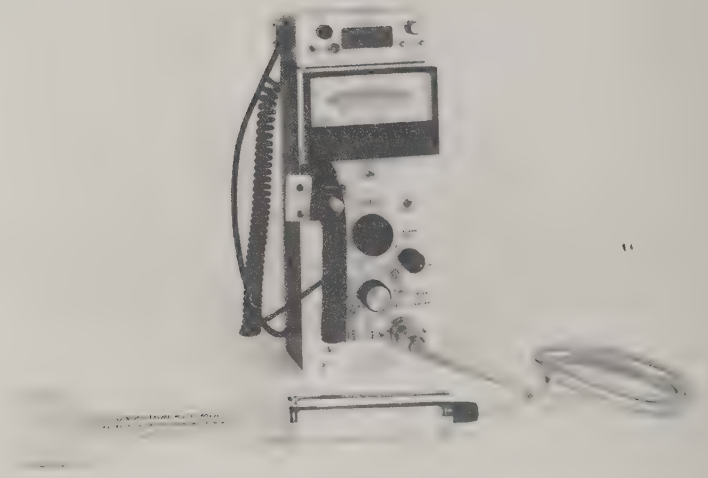


Figure 2-2. Model 8696 RADIATION AVERAGING MODULE Typical Operational Setup

d. Press the START/STOP pushbutton, wait for 5 to 10 seconds and then press the START/STOP pushbutton again.

e. Release the SELF TEST pushbutton. The display should be 50.0 $\pm$ 1.

NOTE

The SELF TEST pushbutton supplies a reference voltage to the input and therefore can be used in any operational mode.

NOTE

Duration of the test is not important since time measurement is achieved with a crystal controlled clock frequency. Any contribution to total accuracy will therefore be a constant.

The reference voltage is factory set to correspond to a recorder output of 1.5V (3.0V fullscale).

2-11. CALIBRATING THE 8696 FOR USE WITH AN 8616 OR 8716.

2-12. The 8696 is factory set for accurate operation with an 8616 or 8716 having 3.0V full scale recorder output.

2-13. The 8716 has a recorder output specification of 3.0V $\pm$ 1%, so for almost all applications the 8696 need not be adjusted.

2-14. The 8616 has a recorder output specification of 3.0V $\pm$ 10% with a typical accuracy of $\pm$ 3%. For precision applications the user may wish to adjust the 8696 for optimum accuracy with a given 8616. Refer to the calibration section for complete procedure.

2-15. OPTIMIZING PROCEDURE.

2-16. A quick procedure for optimizing the 8696 with a given 8616 is as follows:

a. Set the 8616 to MAX HOLD.

b. Place the 8600 Series probe in any available field and obtain a reading on the 8616's meter between half and full scale.

c. Remove the probe from the field. The MAX HOLD mode on the 8616 will maintain the constant analog meter reading and its corresponding recorder output voltage. Translate the meter reading as a percent of full scale (e.g. 1.4 mW/cm^2 on a 2 mW/cm^2 range is 70%).

d. Set the 8696 to SPATIAL and SINGLE. Remove the cap on the unit's top cover. The calibration adjustment potentiometer is directly below the opening.

e. Press START/STOP once, wait 5 to 10 seconds and press START/STOP a second time. Compare the 8696 display to the 8616 meter.

f. To increase the 8696 sensitivity turn the calibration potentiometer CW (nominally 1.5% per 360° rotation) on CCW to decrease sensitivity.

NOTE

The potentiometer should be adjusted while the 8696 is not making a measurement. The display will not change until the next measurement is completed.

g. Repeat steps e and f until the desired accuracy is obtained.

2-17. OPERATION.

2-18. The Model 8696 adds time and spatial averaging capabilities to the 8600 and 8700 Series radiation monitors. Averages may be taken for fixed times of 6 minutes (ANSI standard) or 1 minute (Australian standard). Spatial averages may be taken for any measurement duration from 5 seconds to 6 minutes. Single or repetitive averages may be taken and the elapsed time of a measurement is available upon its completion. The instrument also has variable display update rates.

2-19. A primary consideration during the design of this instrument was ease of use. Since the operator will normally use one hand to hold the 8616 or 8716 meter with the other holding the probe, the controls used during a measurement must be located on the meter handle or the probe. The 8696, therefore, was built in two cases. The main case, which mounts to the 8616 or 8716 meter, has the controls which are set prior to making a measurement, such as fixed or variable time, single or repetitive measurement, etc. The smaller case has two push button controls, one to start and stop a measurement and the other to temporarily interrupt the measurement while moving around obstacles or walking thru areas that are not part of the desired survey. This case mounts to the handle of the 8616 or 8716 and brings the push buttons to the proper position for actuation. Response to the push buttons occurs on release of the button.

2-20. Before entering the radiation field, the 8616 or 8716 meter is zeroed and set to the proper range. The 8696 is then set to the desired measurement mode, for example, a SINGLE SPATIAL measurement. The operator then enters the field, holds the probe in the desired location and verifies that the 8616 or 8716 has been set to the proper range. He then presses the START/STOP push button to start the averaging cycle and begins moving the probe in a uniform manner across the field. If he wishes to interrupt the measurement, he presses the PAUSE button once and then pushes it a second time when he is ready to continue. Response to the button occurs on the release. When the probe has been returned to the starting location, the spatial survey is complete and the operator presses the START/STOP button a second time. The average field strength is displayed on the 8696's LCD as a percent of full scale.

2-21. OPERATIONAL NOTES.

a. The display reads in percent of full scale for the 8616/8716 range used. For example if an 8616 and 8600 series probe is set for 20 mW/cm^2 full scale, then an 8696 display of 25.0 corresponds to: .25 x 20 mW/cm^2 = 5 mW/cm^2 average field strength.

b. All averaging cycles are initiated by pressing the START/STOP button once. The spatial averaging mode is stopped by pressing the START/STOP button a second time. Response to the button occurs on its release. Fixed time averages are stopped automatically after the set time has elapsed, if trigger is in "single" position.

c. The LCD will hold the last measurement until the next measurement cycle is completed. After initial turn on, for example, if a 6 minute fixed time measurement is made first the display will read "0.0" for 6 minutes and then be updated.

d. The PAUSE control may be used in any operational mode. While the "PAUSE" is displayed averaging and elapsed time measurements are halted. The PAUSE control may therefore be used as often as required during any measurement cycle.

e. The update rate control is active only for repetitive, fixed time measurements. The initial reading will occur after the first cycle is completed (1 or 6 minutes), when the trigger is in "auto" position. Thereafter the display will be updated every 10, 30 or 60 seconds (or 6 minutes in 6 minute fixed time only) with the running average over the last 1 or 6 minutes.

f. An overrange, "----", condition during any part of the measurement will cause the final average to be "----". In repetitive measurement modes this display will remain until the overrange time frame is cleared from the running average (1 or 6 minutes).

g. The MODE, TRIGGER and update switches are only scanned after a currently running measurement is complete. Changing the state of the MODE or TRIGGER switches requires starting the next measurement cycle by pressing the START/STOP button.

h. After a SINGLE trigger measurement is made, the elapsed time may be obtained by momentarily pressing the TRIGGER control to the TIME position.

i. MAX HOLD position on 8616 and 8716:

MODEL 8616: The MAX HOLD position on the 8616 should not be used when using the 8696. Both the analog meter and the recorder output are set to maximum hold in this position, therefore true average field strengths will not be obtained.

MODEL 8716: The MAX HOLD position on the 8716 may be used when using the 8696. Only the analog meter is set to maximum hold in this position, while the recorder output is not affected.

2-22. POWER DENSITY MEASUREMENTS ON ROTATING BEAM RADARS.

The Narda Model 8696 is ideally suited for time averaged measurements on rotating radars. Operated in conjunction with the meter and applicable probe, this system can perform accurate monitoring without any of the operator calculations that were required previously (probe time constant, illumination period), and is applicable to fast, or slow, rotating radars.

Thermocouple detectors, while providing true RMS detection of any modulated signal are susceptible to temperature changes. Model 8716 with it's auto-commutating zeroing circuitry is much more stable than Model 8616. However, this section denotes procedures that allow the operator to remove any zero offset, or drift, that may occur during the survey with either series of monitors.

A time-averaged measurement is performed by following the procedures listed in Section II, however, these additional steps may be followed to enhance the repeatability of this measurement.

a. Connect probe to meter and energize system. Allow the system to warm up 15 minutes, in the ambient temperature at which the measurement is to be performed. Do not expose the system to field levels greater than the probes overload rating.

b. With probe in zero density area (carrying case) insure meter reads zero on the most sensitive range, by fine tuning zero control (8716) or, depressing zero switch (8616). Set mode switch position to spatial, press start/stop button, wait five seconds, then press start/stop control again and read 8696 display. The number displayed (typ. 0 to 5) should be retained on paper as the "first zero".

c. Perform the survey using the highest sensitivity range which does not exceed that meter range. Rezero the unit if the range is changed.

d. After performing the averaging measurement, immediately return probe to zero density area and repeat Steb b above, noting the LCD Display result.

e. The two "zero" results should be applied to determine your final average as follows:

Example: 6 min. average = 15.8% of full scale
First Zero = 0.1
Second Zero = 1.5
$Average_f$ = final average

Final average = Displayed average - Zero average

Average - (2nd Zero + 1st Zero)/2 = average f

$$15.8 - \frac{(1.5 + .1)}{2} = \text{average f}$$

15.8 - .8 = 15.0% of full scale

Therefore, in this example, the corrected average is 15.0%. In this way any zero drift and/or offset in the system is removed from the final data.

f. For applications where a slowing rotating beam radar is the only significant radiation source the following method may be used to minimize the effects of zero drift. This method uses the "Pause" control and the "Time" recall capability of the 8696. The only additional equipment required is a stop watch or a wrist watch with a second hand.

1. Set the 8696 controls and zero the 8616/8716 on the highest range which does not peg the analog meter per steps a, b and c above.

2. Note the starting time on your wrist watch (or start the stop watch) and press "Start/Stop" once on the 8696 remote box.

3. As the radar beam passes the survey point and the 8616/8716 analog meter returns to zero press "Pause" once. "PAUS" will be displayed on the 8696.

4. Press "Pause" again to continue the measurement as the radar beam again approaches the survey point and before the analog meter deflects off zero. The 8696 cannot be left in the "PAUS" state during any radar beam passes. Restart the survey if any beam pass is missed.

5. Continue using the "Pause" button as in steps 3 and 4 until at least 10 radar beam passes have been monitored. Press "Start/Stop" once to complete the survey and note the stop time on your wrist watch. Note the survey average on the LCD.

6. Set the 8696 trigger control toggle switch to "TIME" (momentary position) and record the survey time displayed on the LCD.

7. Note the final zero as in step d above.

8. Calculation:

(a) Calculate average per step e.

(b) Calculate ratio of survey time to total time.

(c) Multiply average (a) by time ratio (b) to determine final average.

EXAMPLE:

First zero:	0.3
Second zero:	3.2
Survey average:	28.9 (from LCD)
Survey time:	32.6 seconds (from LCD)
Start time:	10:05:00 (from wrist watch)
Stop time:	10:08:00 (from wrist watch)
Elapsed time:	3 minutes (180 seconds)

Average during active survey:

$$28.9 - \frac{(3.2 + 0.3)}{2} = 27.2\% \text{ of full scale}$$

Ratio of survey time to total time:

$$32.6/180 = 0.181$$

Final average:

$$27.2\% \times 0.181 = 4.92\% \text{ of full scale}$$

SECTION III

THEORY OF OPERATION

3-1. BLOCK DIAGRAM DISCUSSION. (Figure 3-1)

3-2. The incoming analog signal from the 8616 or 8716 recorder output is sent to a V to F converter which feeds an interrupt line on the microcontroller. The microcomputer counts the input pulses and divides the sum by the time duration of the measurement. This result is then scaled, coded and sent to the display section. A crystal is used to obtain accurate time duration data. The MODE, START/STOP and PAUSE control switches provide input instructions to the microcomputer.

3-3. BUILT IN TEST FUNCTIONS.

3-4. Several BIT functions have been incorporated to enhance ease of use, operator confidence and facilitate repair. At turn-on, the microcomputer tests its internal RAM and the memory section. Error codes are displayed on the LCD if a fault is detected. The LCD is then set to display the model number, which allows the operator to verify proper display section operation. A "LO BATT" annunciator is displayed when the battery voltage drops below the necessary level.

3-5. A SELF TEST push button allows the accuracy of instrument to be verified. The input from the recorder jack is disconnected and a reference voltage, equivalent to a

half-scale reading, is sent to the V to F converter.

3-6. If the operator sets the mode control switches to an improper combination of conditions, an error code is displayed.

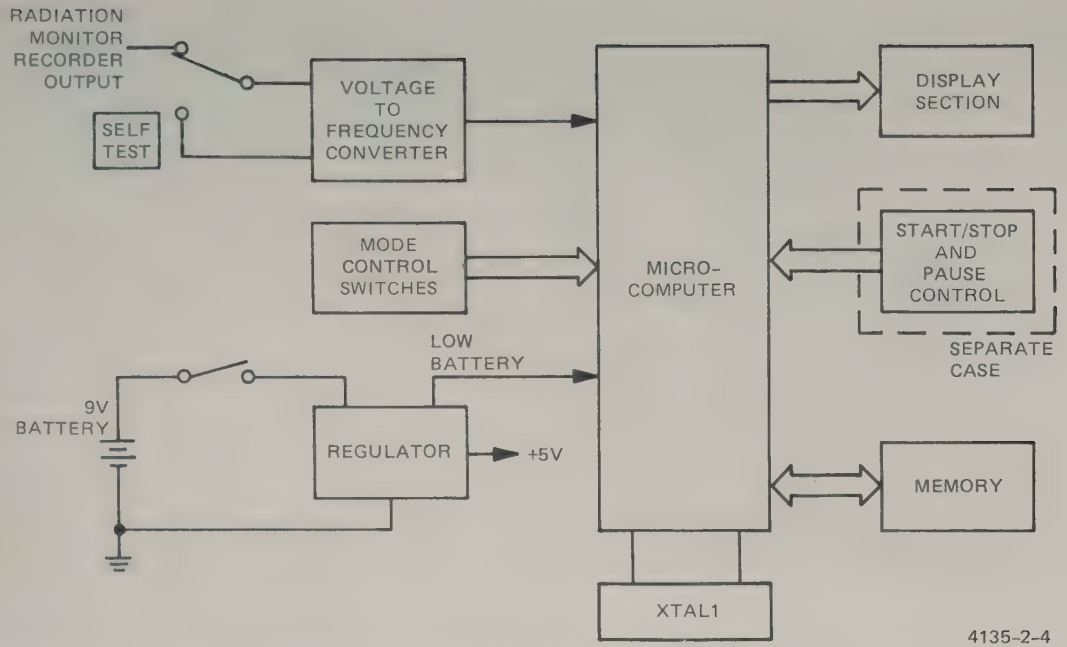


Figure 3-1. Model 8696 RADIATION AVERAGING MODULE Simplified Block Diagram

SECTION IV

MAINTENANCE

CAUTION

Static sensitive components. Disassembly and calibration should be done at anti static workstation.

4-1. CALIBRATION.

4-2. Equipment Required for Calibration.

a. Frequency Counter: 1 Hz to 2 MHz, Zin≥ 100 Kohms

b. DVM: 4 1/2 DIGIT

c. Power Supply: 0 to 3V

d. Oscilloscope Probe: X10

4-3. CALIBRATING AN 8696 FOR USE WITH AN 8716.

a. Partially separate the front panel of Model 8696 from the case by removing the two flat screws on the rear of the case. Caution should be used to avoid breaking wires on TP3 and 4 or losing the RF shielding strips around the edges of the case.

b. Turn power on and set switches to SPATIAL and SINGLE.

c. Measure XTAL frequency on pin 18 of microcomputer, U3, pin 18. Frequency should be 1.8432 MHz ± 0.1%.

d. Connect the negative lead of the power supply to E1 and the positive lead to TP1. Connect the frequency counter probe to R14.

e. Set power supply to 3.00V. Press the START/STOP switch once. Adjust R5 for a display of 300.0 Hz ± 0.5 Hz on the frequency counter.

NOTE

A measurement should be in progress, as indicated by a flashing display while adjustments are made.

f. Set the power supply to 0.300V. Frequency counter should read 30.0 Hz ± 0.5 Hz.

g. Depress and hold the SELF TEST pushbutton. Adjust R8 for a display of 150.0 Hz on the frequency counter.

h. Slip the RF shielding strips back over the edge of the case and reassemble case to front panel.

i. Depress and hold the SELF TEST pushbutton. Press START/STOP once, wait for 5 to 10 seconds and then press START/STOP again. LCD should display 50.0 ± 0.5.

j. Depress PAUSE. LCD should display PAUS. Depress PAUSE again.

4-4. CALIBRATING AN 8696 FOR USE WITH AN 8616.

a. The recorder output of an 8616 has a specified accuracy of ±10% with a typical accuracy of ±3%. To obtain maximum system accuracy the 8696 may be calibrated for operation with a particular 8616.

b. Perform the procedures given in paragraph 4-3, steps a thru c.

c. Refer to the manual for the 8616 and connect the 8616 to the test fixture shown in figure 4-1. Follow the range calibration procedure contained in paragraph 4-12 for a full scale indication on the 8616.

d. Depress the 8696's START/STOP pushbutton, wait for 5 to 10 seconds and press the START/STOP pushbutton again.

e. The LCD should display 100.0 ± 2.0. Adjust R5 if display is not correct. Gain change is nominally 1.5% per 360° rotation of potentiometer.

f. Repeat steps d and e until proper display is obtained without further readjustment of R5.

g. Verify ±2% of full scale accuracy as 8616 indication is lowered to zero.

h. Depress and hold the SELF TEST pushbutton. Press the START/STOP pushbutton, wait 5 to 10 seconds and press the START/STOP pushbutton again. Then release the SELF TEST pushbutton.

i. The LCD should display 50.0 $\pm$ 1.0. Adjust R8 if display is not correct.

j. Repeat steps h and i until proper display is obtained without further readjustment of R8.

k. Reassemble case to front panel and test as given in paragraph 4-3, steps h, i, and j.

4-5. TROUBLESHOOTING.

CAUTION

Static sensitive components. Disassembly and calibration should be done at anti static workstation.

4-6. Before troubleshooting the 8696 read Section III, Block Diagram Discussion and Built In Test Functions, and review Table 2-2, LCD Annunciators and Codes. A review of the Operational Notes, paragraph 2-21, may also be useful. Refer to Section VI for the Schematic Diagram.

4-7. A list of test equipment required for troubleshooting the 8696 is given in paragraph 4-8. Be sure to review the troubleshooting notes contained in paragraph 4-9 by beginning troubleshooting procedures in Table 4-1.

Table 4-1

Troubleshooting Chart

Indication	Probable Causes
A. Display of "E1"	U3 Defective.
B. Display of "E2"	U4 or U5 Defective.
C. Display of "Lo BATT"	Battery low or U8 Defective.
D. No display at turn on	1) Contrast control set full CCW. 2) Dead battery. 3) U8 defective - check for 5V on Pin 1. 4) U6 or U7 defective - check for bus activity on Pins 3, 4 and 5 of U3. If all 3 lines have bus activity the fault is in U6 or U7. 5) If items 1-4 do not correct problem then fault is in U3, 4 or 5. Check for clock input (U3, Pin 18) and 5V RESET (U3, Pin 14). If still not operational, replace U3, U4, and U5.
E. Improper display characters	See D, 4 and 5.

Table 4-1 (Cont)

Indication	Probable Causes
F. Elapsed time is not accurate	Crystal, XTAL1 defective.
G. Inaccurate measurements	U2 defective or 8616/8716 recorder output defective. Use SELF TEST push-button for determination.

4-8. EQUIPMENT REQUIRED FOR TROUBLESHOOTING.

a. Oscilloscope - Bandwidth 10 MHz minimum

b. Frequency counter - .1 Hz to 2 MHz (optional)

c. DVM - 4 1/2 digit

4-9. TROUBLESHOOTING NOTES.

a. SELF TEST at turn on checks internal RAM (U3) and memory (U4 & U5) thus eliminating most difficult debugging.

b. Observing the LCD at turn on for "8696" display can be used to verify display section (U6 & U7).

c. U2 is a linear voltage to frequency converter with proper frequency outputs of 300 Hz with 3 V on TP1 and 0 Hz with 0V on TP1.

d. U8 is a linear voltage regulator with a normally high logic level on the ERROR pin.

e. All I.C.s are mounted on sockets to facilitate replacement and troubleshooting by substitution.

SECTION V

REPLACEABLE PARTS

5-1. GENERAL.

5-2. This section contains a listing of the replaceable parts of this unit. The listing contains the necessary ordering information. Complete descriptions of each component are provided in addition to the manufacturers code and the Narda part number. (See Tables 5-1 and 5-2)

5-3. ORDERING INFORMATION.

5-4. If it is desired to order replacement parts from the instrument manufacturer, address the order to:

Customer Service Department
The Narda Microwave Corporation
435 Moreland Road
Hauppauge, NY 11788

5-5. When ordering parts in this manner, the following information should be provided:

a. Model and serial number of the instrument.

b. Narda part number.

c. Reference designation.

d. Description.

5-6. When ordering components or parts not listed in Table 5-2, a complete description of the part including its function and location should be provided with the model and serial number of the instrument.

5-7. CUSTOMER REPAIR SERVICE.

5-8. Repairs or recalibration of Narda Products are performed by the Customer Service Department at the factory; however, before returning any unit, contact the Narda Microwave Corporation or the local Narda Sales Representative in your area for shipping instructions.

Table 5-1

Manufacturer's Code

Manufacturer's Supply Code	Name and Address
01121	Allen Bradley Co. Milwaukee, WI
01295	Texas Instruments, Inc. Dallas, TX
04713	Motorola, Inc. Phoenix, AZ
17117	Elec. Moulding Woonsocket, RI
27014	National Semiconductor Corp. Santa Clara, CA

Table 5-1 (Cont)

Manufacturer's Supply Code	Name and Address
28480	Hewlett Packard Palo Alto, CA
50412	LXD Beechwood, OH
51406	Murata-Erie Rockmar, GA
51640	Analog Devices, Inc. Wilmington, MA
56289	Sprague Electric Co. North Adams, MA
59350	Texas Inst. Attleboro, MA

Table 5-1 (Cont)

Manufacturer's Supply Code	Name and Address
61429	Fox Electronics Ft. Myers, FL
72619	Dialight Div., Amperex Electronic Corp. Brooklyn, NY
80294	Bourns Instruments, Inc. Riverside, CA
81073	Grayhill Lagrange, IL
84411	ASC Ogallala, NE
90303	Duracell Bethel, CT

Table 5-1 (Cont)

Manufacturer's Supply Code	Name and Address
93790	Cornell-Dublier Electronics New Bedford, MA
95146	Augat-Alcoswitch N. Andover, MA
99899	The Narda Microwave Corp. Hauppauge, NY

Table 5-2

Replaceable Parts List

Ref. Des.	Description	Mfg. Code	Mfg. Part Number	Narda Part No.
B1	Battery 9V, .55 Ah	90303	MN 1604	88017000
C1, C2	Capacitor, 0.1 uf, 50V	51406	8121-050-651-104M	80214008
C3	Capacitor, 0.180 uf, 50V, 10%	84411	X463UW	80727000
C4, C5	Capacitor, 15 pf	93790	CD15C150F0	80115010
C6	Capacitor, Tant, 2.2 uf, 25V	56289	196D225X9025HAI	80261007
C7	See C1			
C8	See C1			
C9	See C1			
C10	See C1			
C11	See C1			
CR2	Diode	28480	1N6263	84585004
CR3	Diode	04713	1N4148	84883000
CR4	Diode	04713	1N4148	84883000
CR5	Diode	04713	1N4148	84883000
R3	Resistor, 10K Ohm, 1%	01121	RN55D1002F	83049288

Table 5-2 (Cont)

Ref. Des.	Description	Mfg. Code	Mfg. Part Number	Narda Part No.
R5	Potentiometer, Multiturn, 500 Ohm	80294	3299W-1-501	83246000
R6	Resistor, 1.62K Ohm, 1%	01121	RN55D1621F	83049212
R7	Resistor, 16.2K Ohm, 1%	01121	RN55D1622F	83049308
R8	Potentiometer, Multiturn, 5K Ohm	80294	3299W-1-502	83246003
R9	Resistor, 330K Ohm, 1/8W, 5%	01121	RC05GF335T	83174126
R10	Resistor, 20K Ohm, 1/8W, 5%	01121	RC05GF203T	83174097
R11	Resistor, 100K Ohm, 1/8W, 5%	01121	RC05GF105T	83264000
R12	Potentiometer, 25K Ohm	01121	SPSG040S253U	83312000
R13	Resistor, 62K Ohm, 1/8W, 5%	01121	RC07GF623T	83174109
R14	Resistor, 20K Ohm, 1/8W, 5%	01121	RC05GF203T	83174097
R15	Resistor, 40.2K Ohm	01121	RN55D4023F	83049345
S1	Switch, Pushbutton	72619	583-1121-021	83764000
S2	Switch, Toggle	72619	573-1131-0602-204	83763000
S3	Switch, Pushbutton	81073	39-1	83766000

Table 5-2 (Cont)

Ref. Des.	Description	Mfg. Code	Mfg. Part Number	Narda Part No.
S4	Switch, Toggle	72619	573-1431-0602-204	83763001
S5	Switch, Toggle	72619	573-1231-0602-204	83763002
S6	Switch, Rotary	81073	39-1	83766000
S7	Switch, Pushbutton	95146	MRS-1-10PC	83765000
U2	Integrated Circuit	27014	AD537KH	84951000
U3	Integrated Circuit	01295	TMS70C00ANL	84952000
U4	Integrated Circuit	01295	74HC373	84953000
U5	Integrated Circuit	27014	NM 27C16HQ-45	84954000
U6	Integrated Circuit	27014	COP472N-3	84955000
U7	LCD Display	50412	353-R3R03GHZ	84947000
U8	Integrated Circuit	27014	LP295ICN	84956000
XTAL1	Crystal, 1.8432 MHz	61429	FOX0185	84945000
XU2	Socket, IC, Circular, 10-pin	17117	7010-362-5	89080001
XU3	Socket, IC, 40-pin	59350	C93-40-02	89075008
XU4	Socket, IC, 20-pin	59350	C93-20-02	89075003
XU5	Socket, IC, 28-pin	59350	C93-28-02	89075007
XU6	Socket, IC, 20-pin	59350	C93-20-02	89075003
XU8	Socket, IC, 8-pin	59350	C93-08-02	89075000

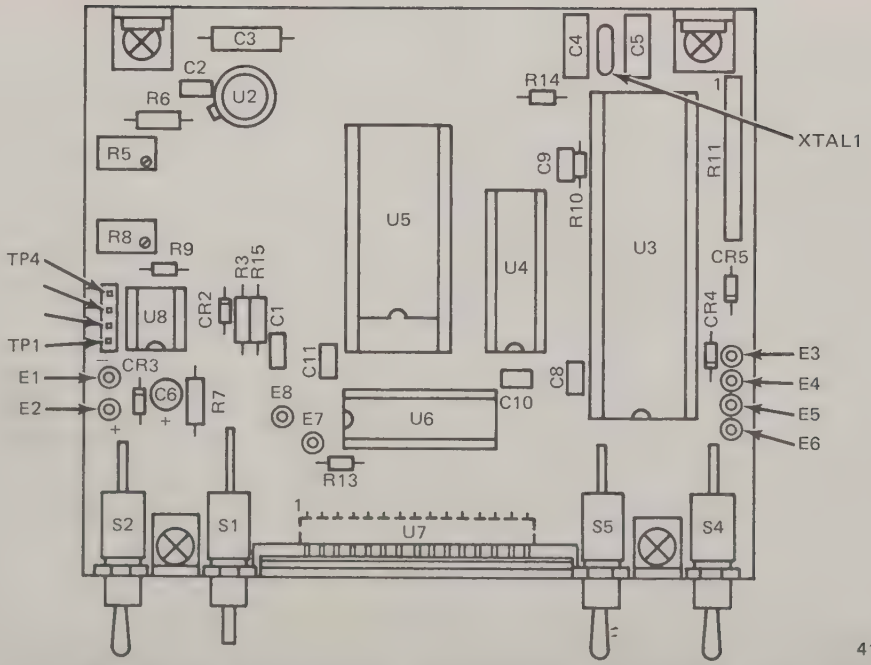


Figure 5-1. Model 8696 RADIATION AVERAGING MODULE Parts Location Diagram.

SECTION VI

SCHEMATIC DIAGRAM

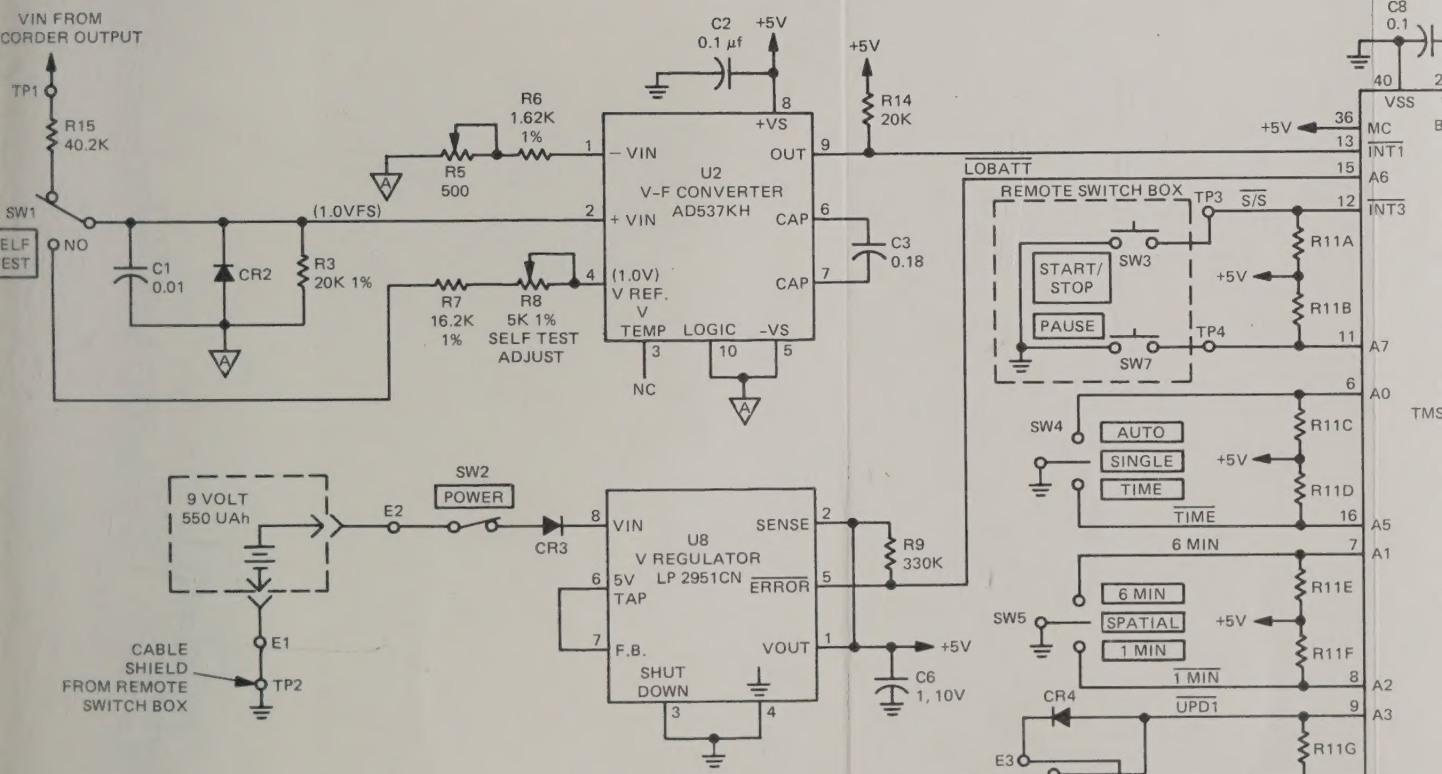
6-1. GENERAL.

6-2. This section provides the schematic diagram required for the maintenance of the Model 8696.

6-3. Figure 6-1 is the complete 8696 schematic. The following notes are applicable:

a. Dashed lines are used to designate parts not on front panel or PC board eg. battery and separate case for switches.

b. Test points and terminals are indicated by circles.



NOTES:

UNLESS OTHERWISE NOTED

1. ALL RESISTORS ARE IN OHMS 1/8W, 5%
2. ALL PULLUP RESISTORS ARE 100KΩ (R11A THRU H)
3. ALL CAPACITANCE IS IN UF.
4. DIODES CR1 & CR2 ARE IN6263 (HYBRID SCHOTTKY) OTHERS ARE IN4148

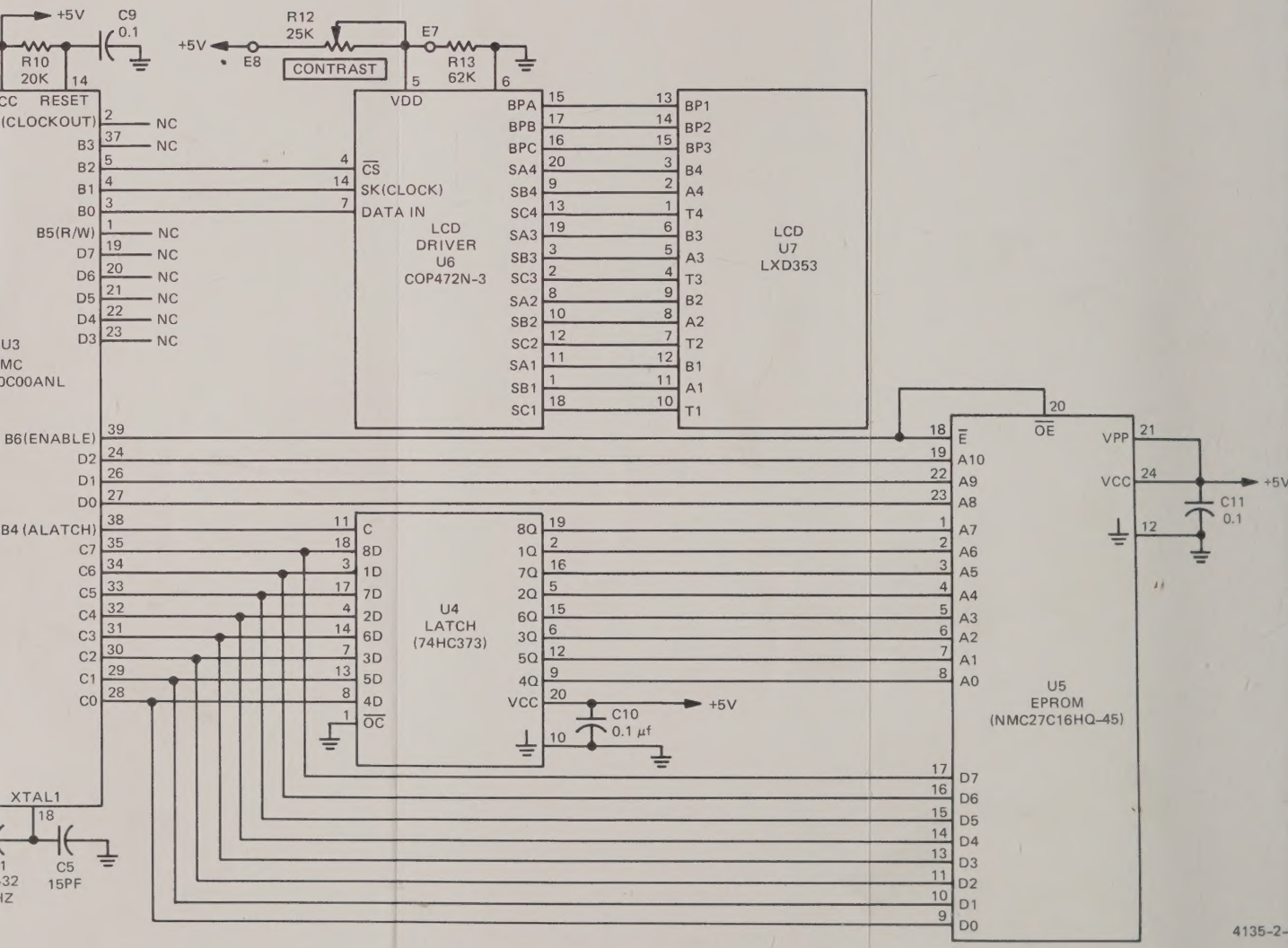


Figure 6-1. Model 8696 RADIATION AVERAGING MODULE Schematic Diagram